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ABSTRACT

An annual survey was conducted of the career plans of 1992 recipients of bachelors degrees in physics and astronomy. The survey has been carried out every year since the 1960s and is a reliable indicator of the graduates' postbaccalaureate intentions and how those trends reflect America's changing economy. For the 1992 survey 2715 of 4965 physics bachelors degree recipients responded. Of astronomy degree recipients, 130 of 186 responded. Three main findings included the following: (1) a lingering recession makes graduate study more attractive than employment at the bachelor's level; (2) since the mid-1980s the proportion of holders of bachelors degrees in physics who become high school teachers has doubled; and (3) only one-third of the employment-oriented physics bachelors degree holders reported making extensive use of their training. The study also found that women, foreign minorities, and United States Asians ranked highest in the proportions of bachelor degree holders who entered graduate study in physics or astronomy. From the survey of astronomy graduates, the survey sample contained proportionately more women, and fewer minorities. This area also shows a shift toward further graduate study and away from employment with only the bachelor's degree. Only 31 percent of astronomy graduates intended to pursue employment directly after college graduation. The paper includes three figures and seven tables displaying the data. (JB)

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AIP REPORT

EDUCATION & EMPLOYMENT
STATISTICS DIVISION

Tel. 212-661-9404

by Susanne D. Ellis
and Patrick J. Mulvey

AIP Pub. No. R-211.24

March 1993

1991–92 SURVEY OF PHYSICS AND ASTRONOMY BACHELOR'S DEGREE RECIPIENTS

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For a majority of the physics and astronomy graduates the choice of discipline was a decision they had made before they entered college. As seniors, and having completed all the requirements for their bachelor's degrees, they are in a position to match the breadth and flexibility of their subject matter to the career opportunities they are seeking. Dating back to the 1960s, this survey is a reliable indicator of the graduates' postbaccalaureate plans and how those trends reflect our changing economy. This report is based on the information contributed by the graduates in the class of 1992 and its highlights are:

- A lingering recession makes graduate study more attractive than employment at the bachelor's level.
- Since the mid 1980s the proportion of physics bachelors who became high school teachers, doubled.
- Only one-third of the employment-oriented physics bachelors reported making extensive use of their training.

The three broad categories of postbaccalaureate plans, graduate study, employment, and no immediate plans, are subdivided into five groups and presented in **Table I** which compares the three most recent classes of graduates with the class of 1985. Thus, the potential graduate students are divided according to subject of graduate study. Those who remained in physics, astronomy or a cross-disciplinary area were separated from those whose interests may have ranged anywhere from a science-related discipline to a career in business or the humanities; the latter group is listed under the heading of "other graduate study." The employment group is also divided into two subgroups because the experiences of graduates who need to deal with the economic pressures of a changing job market are very different from those for whom the military service has commissions lined up or offers for additional specialized training. The fifth group of bachelors, though small, consists of graduates who had no specific plans upon receiving their bachelor's degrees; this group has increased from two to five percent. Thus the trend in **Table I** indicates a clear shift from civilian employment to graduate study, thereby reflecting the shrinking manufacturing economy. On the other hand, the need for a technically trained work force remains a problem. The sizes of the four graduating classes shown in **Table I** indicate little change except for a three percent decline in 1992.

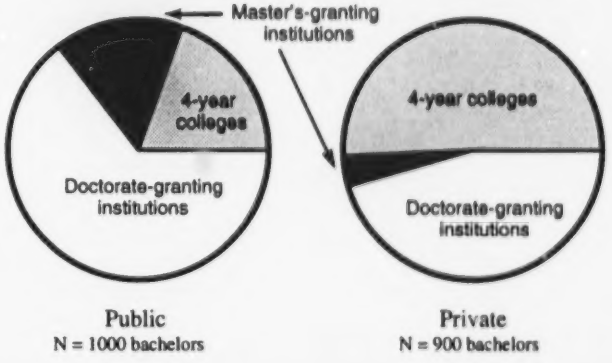
Table I. Postbaccalaureate plans of selected graduating classes of physics bachelors, 1985 to 1992.

Postbaccalaureate plans	1984–85	1989–90	1990–91	1991–92
Physics/Astronomy* graduate study	32%	35%	38%	38%
Other graduate study	18	18	18	21
Civilian employment	43	38	35	32
Military service	5	5	5	4
Undecided	2	4	4	5
Total number of physics bachelor's degrees	5188	5111	5145	4965

**A revised classification of cross-disciplinary areas is included under "Physics/Astronomy."*

It is generally thought that potential physicists, as undergraduates, distinctly favor those institutions that are known for their research environment, which by and large are the doctorate-granting institutions. To substantiate or disprove this statement, we examined the baccalaureate sources of potential graduate physics students and found that, particularly among the private institutions, four-year colleges play a major role in sending their physics bachelors directly to graduate schools. For more detail on the proportions in which institutions contribute to the class of first-year graduate students, we present **Figure I** which separates the public from the private institutions and subsequently divides each group on the basis of highest physics degree granted. On the other hand, it should be noted that physics bachelors from doctorate-granting institutions are most likely to pursue physics graduate study as shown in **Table II**.

Figure I. Public and private institutions as sources of graduate physics/astronomy students, 1992.



Member Societies: The American Physical Society • Optical Society of America • Acoustical Society of America • The Society of Rheology • American Association of Physics Teachers
American Crystallographic Association • American Astronomical Society • American Association of Physicists in Medicine • American Vacuum Society • American Geophysical Union

Table II. Characteristics of new physics bachelors, 1991–92.

Characteristics		Postbaccalaureate plans: Graduate study – Physics/ Astronomy	Graduate study – Other	Employment	Undecided	Total
Initial interest in physics**	Curiosity about nature	25%	23%	30%	32%	27%
	Its presentation in high school	21	25	22	19	22
	Its presentation in college	10	8	9	9	9
	A subfield of physics	11	13	11	10	11
Sex	Female	18%	15%	17%	22%	17%
	Male	82	85	83	78	83
Citizenship	U.S.	93%	91%	97%	92%	94%
	Foreign	7	9	3	8	6
Age	21 or younger	9%	9%	3%	2%	6%
	22	50	48	36	33	44
	23	22	21	23	25	22
	24–27	13	16	23	25	18
	28 or older	6	6	15	15	10
Minority group	U.S. blacks	1%	3%	2%	2%	2%
	U.S. Hispanics	2	1	2	1	2
	U.S. Asians	5	5	4	11	5
	Foreign minorities	5	7	2	5	4
Transfer students from 2-yr institution		8%	7%	13%	16%	10%
Type of degree	Bachelor of science	76%	66%	75%	70%	73%
	Bachelor of arts	24	34	25	30	27
Type of bachelor's institution	PhD-granting	56%	44%	44%	55%	47%*
		43	**19**	**32**	**6**	**100%**
	MS-granting	10	8	11	8	11*
		39	**16**	**41**	**4**	**100%**
	BS/BA-granting	34	48	45	37	42*
		31	**25**	**40**	**4**	**100%**
Total number of bachelors		1886	1035	1803	241	4965*
% distribution		38%	21%	36%	5%	100%
Number of respondents		1031	566	986	132	2715

**Data derived from the survey of Enrollments and Degrees.*

***The answers from the remaining third of the respondents ranged from citing public television programs to mentioning that a member of the family is a physicist.*

For **Table II** we selected eight characteristics of new physics bachelors that vary with respect to postbaccalaureate plans. The first characteristic listed explores the factors that prompted the graduates' interest in physics and for the third successive year, the appeal of the subject matter was the most popular answer. The background characteristics of sex and citizenship indicate less variation between the total group and its subgroups; but the age distributions are examples for which differences occur. For example, the total column shows that 50% of all physics bachelors are 22 years or younger; however, for its two largest subgroups (the potential graduate physics students and the employment group) 59% and 39% are the respective proportions of graduates whose ages are 22 or younger. The last characteristic, showing the three types of bachelor's institutions for the class of '92, was added to this year's version of **Table II**. We included horizontal percentages in addition to the vertical ones for each group because they constitute a more meaningful analysis of that characteristic.

Table III. A comparison between men and women among the 1991–92 physics bachelors and their high school physics backgrounds.

Type of high school physics		Women	Men	Total N	Total %
PSSC*		3%	4%	98	4%
Project physics		1	2	42	2
AP physics		22	23	616	23
General physics		61	62	1664	62
None		13	9	254	9
Total respondents	%	100%	100%		100%
	N	463	2211	2674	

**PSSC = Physical Science Study Committee.*

There is a shifting perception of just how influential high school physics courses were for those who had chosen physics to be their major. **Table III** lists four types of physics courses and compares the proportions of men and women who enrolled in each; those percentages have been relatively stable with one exception: The proportion of graduates who were not introduced to physics until they reached college, definitely declined. Currently 9%; it was as high as 13% for the class of 1989.

Although sex is among the characteristics included in **Table II**, we have added women physics bachelors to the minority groups shown in **Table IV**. Our justification for this addition is that women constitute a minority among the physics students and the distribution of their postbaccalaureate plans differs sufficiently from that of the other groups in that table. For example, women along with foreign minorities and U.S. Asians rank highest in the proportions of bachelors who entered graduate study in physics or astronomy.

Table IV. Postbaccalaureate plans of selected minority groups and women among the responding physics bachelors of the class of 1992.

Minorities	Postbaccalaureate plans: Graduate study Physics/ Astronomy	Graduate study Other	Empl.	Total %	Total N*
Native American Indians	**	**	**	100%	8
U.S. blacks	27%	35%	38%	100	48
U.S. Hispanics	38	12	50	100	48
U.S. Asians	43	22	35	100	125
Foreign minorities	44%	38%	18%	100%	109
All women	44%	18%	38%	100%	441
All respondents	40%	22%	38%	100%	2583

**N's do not include respondents with "no immediate plans."*
***Insufficient data*

To focus on the relative sizes of U.S. minority groups among the physics bachelors, we compare them with their foreign counterparts and include in **Table V** those bachelors who had not yet decided on a postbaccalaureate plan. The table presents four characteristics, the first of which shows that women comprise one quarter of the U.S. minority graduates compared with 14% of the foreign physics bachelors.

Table V. Selected characteristics of minority physics bachelors, 1992.

		Minority groups								
		Black U.S.	Black Foreign	Native American Indian	Hispanic U.S.	Hispanic Foreign	Oriental U.S.	Oriental Foreign	Other Asian U.S.	Other Asian Foreign
	Respondents:	50	9	8	49	6	103	57	37	43
Sex	Female	12	–	2	8	–	28	11	9	5
	Male	38	9	6	41	6	75	46	28	38
Age	21 or younger	4	–	–	2	–	10	2	8	4
	22	13	1	2	11	–	36	12	12	12
	23	12	–	2	12	3	30	26	6	14
	24	6	1	–	5	–	7	7	1	3
	25–27	8	4	2	13	2	10	8	7	8
	28 or older	7	3	2	6	1	10	2	3	2
Region* of bachelor's institution	Northeast	6	4	2	10	2	31	13	11	16
	Southeast	19	1	1	5	2	10	4	3	8
	Central & Mountain	18	3	4	24	1	14	15	12	15
	Pacific	7	1	1	10	1	48	25	11	4
Type of bachelor's institution	PhD-granting	16	3	3	23	1	68	35	25	19
	MS-granting	8	1	1	10	2	8	3	2	1
	BS/BA-granting	26	5	4	16	3	27	19	10	23
	Public	29	4	5	37	2	64	27	21	18
	Private	21	5	3	12	4	39	30	16	25

**Regions: Northeast = New England, Middle Atlantic; Southeast = South Atlantic, East South Central; Central = East North Central, West North Central, West South Central.*

Table VI. Sources of anticipated support for first-year graduate study*, 1990 to 1992.

Sources of support	Students planning: physics/astronomy graduate study**			other graduate study		
	1990	1991	1992	1990	1991	1992
Teaching assistantship	45%	44%	44%	15%	13%	15%
Research assistantship	14	13	12	15	14	12
Fellowship	21	21	20	16	18	13
Family, savings, loan	4	5	6	30	31	34
Part-time employment	6	6	6	17	16	17
Other	1	1	1	1	2	4
Multiple: TA/RA	4	5	6	3	3	3
Multiple: TA/Fellowship	4	3	3	1	1	1
Multiple: TA/Family, savings, loan	1	2	2	2	2	1
	100%	100%	100%	100%	100%	100%
Graduate study status: full-time	95%	95%	94%	85%	88%	84%
Graduate study status: part-time	5	5	6	15	12	16
Total number of full-time students	1762	1888	1886	966	998	1035

The information was reported for September of each academic year.
***Earlier versions of this table included astronomy and cross-disciplinary areas of physics under "Other graduate study."*

Since it remains uncertain just when the economy will noticeably recover, available sources of support for graduate studies take on added importance. **Table VI** links subject of graduate study to five sources of support as it compares the physics bachelors who remain in their discipline with those who change to a different subject of study. The typical source of support for a first-year graduate physics student is a teaching assistantship. By contrast, the largest proportion of the group of physics bachelors who entered "other graduate study" is the one that reported support from "Family, savings or loan." Another major difference comes to light when we compare the proportion of bachelors in each group who resorted to part-time employment off campus; only 6% of the potential physicists reported these sources of support in contrast to 17% of the nonphysics graduate students.

Full-time employment, as a source of support, was deliberately omitted from the listing in **Table VI** because the analysis was intended to be based on full-time graduate study. However, approximately 10% of the bachelors who had accepted employment, pursued graduate studies on a part-time basis; their distribution is presented in the lower portion of the table.

An important pillar of the economy is the college-educated graduate who is interested in immediate employment. To see how well the new physics bachelors fared in 1992, we analyzed the demand for them in terms of the number of job offers they received and compared this information with data from earlier years. **Table VII** presents a scale of no offers, one offer and multiple offers for the most recent three years and adds 1985, 1980 and 1975 for purposes of comparison. The first category, "zero job offers," may require some clarification so as not to mistake it for a general unemployment rate; it refers to the period immediately after graduation when many bachelors may not yet have allotted time to explore the job market. Thus a clear trend emerges that began in 1980. The proportion of graduates who reported "zero job offers" rose sharply in eleven years (10% to 22%) while bachelors with multiple offers steadily declined (40% to 11%). Surely, those statistics can be considered a gauge of the economy. On the other hand, let us not ignore the most recent data points in **Table VII** which could be viewed as signalling the first trend reversal since 1980.

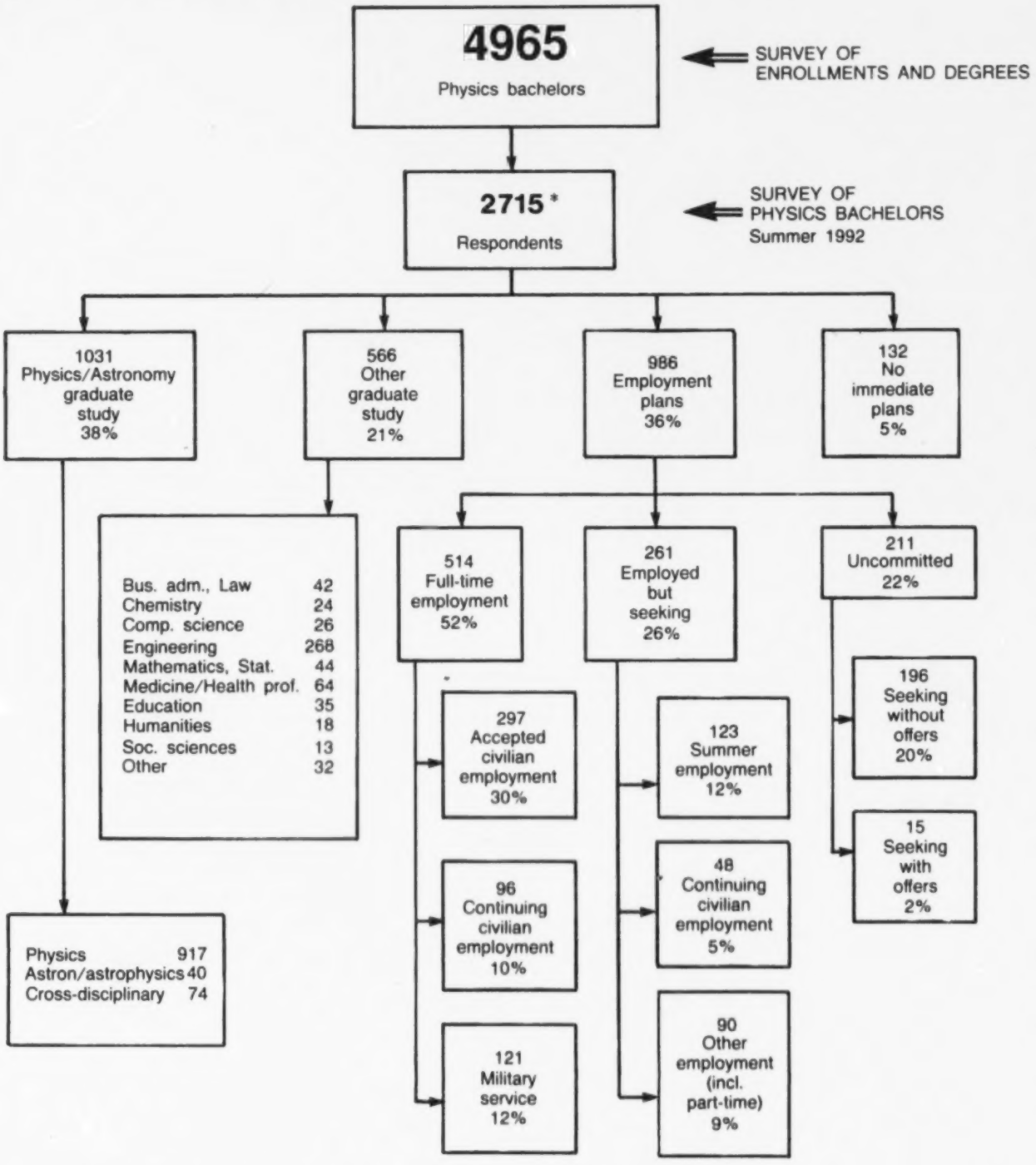
As part of the search for signs of an economic recovery, we outline in **Figure II** the accounts contributed by almost 1000 new physics bachelors who sought initial employment in 1992. Their descriptions fall into three groups the largest of which, comprising 52%, concerns graduates who reported stable full-time employment. The second group described itself as "employed and seeking" because the positions they held either lacked permanence or were holdovers from their student days. The members of the remaining group were still actively seeking employment when they responded to this survey. **Figure II** also elaborates on the postbaccalaureate plans of the potential graduate students by listing the subjects of study they chose.

Table VII. Changes in employment outlook for new physics bachelors, 1975 to 1992.

Number of job offers at graduation	Summer 1975	Summer 1980	Summer 1985	Summer 1990	Summer 1991	Summer 1992
0	17%	10%	14%	17%	22%	20%
1*	56	50	59	68	67	69
2 or more	27	40	27	15	11	11

Bachelors who enter the military are included here.

Figure II. Postbaccalaureate plans of physics bachelors of the class of 1992.



*Includes astronomy bachelors from Figure III who reported a double major with physics.

Table VIII. Initial U.S. or foreign employment of physics bachelors from the classes of 1981 to 1992.

Type of employer*	Percentage of employed bachelors					
	1980–81	1984–85	1988–89	1989–90	1990–91	1991–92
Industry { manufacture	40%	33%	29%	28%	21%	20%
Industry { service	22	18	19	18	21	23
High school	2	5	5	8	9	11
College or university	4	4	5	5	7	5
Government { civilian	7	14	12	14	12	9
Government { military	21	23	27	25	27	29
Other	4	3	3	2	3	3
Total	100%	100%	100%	100%	100%	100%

**Re-definitions of categories make the data in this table not directly comparable to those in earlier published reports.*

By going back to 1981, **Table VIII** presents a clear trend of the initial employment opportunities that major types of employers offered to new physics bachelors. During this twelve-year period, industry remained the dominant employer but its declining manufacturing portion gradually reduced a 40% contingent to 20% with new graduates shifting into high school teaching positions and into military service. On the other hand, the substantial growth of our service industry is not reflected in those minor fluctuations that ranged from 18 to 23% in **Table VIII**. The small group of bachelors who had accepted foreign initial employment comprised only 1%, and all the graduates were U.S. citizens.

To present a comprehensive picture of the starting salaries offered by the major groups of employers, **Table IX** divides industry into three parts and separates the salaries reported by men from those paid to women. By using this format, we are calling attention to significant salary differences. For example, the highest median salary is the one reported by women whose positions involve the manufacture of technical products. An important factor that determines salary levels is the extent to which a physics bachelor uses his or her training. Even the service industry will pay relatively high salaries as long as it utilizes the graduates' technical training. There was no change in the overall median salary from the previous year, though a change in the employer distribution for women lowered their median salary by 8%.

The tables that deal with initial employment, by definition, exclude those bachelors who did not seek employment in 1992 because they had decided to remain with the employers for whom they worked before receiving their bachelor's degrees. However, their types of employers and work activities are similar to those of the newly-employed physics bachelors, hence we present **Table X** which combines the two groups. This table links the four major types of employers to eight work activities and indicates to what extent the graduates believe they are using their physics training. There was virtually no change from the previous year in the employer distribution and "nonphysics professional work", which includes management training, remained at 19%.

Table IX. Starting salaries of physics bachelors in the U.S., class of 1992.

Type of employer	Men (283 reported salaries)		Women (56 reported salaries)		Total (339 reported salaries)	
	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary	Dist. by employer	Median monthly salary
Industry { manuf. { technical products	18%	$2500	10%	$2890	16%	$2500
Industry { manuf. { other products	3	**	5	**	4	1875
Industry { service	22	2310	26	2020	23	2250
High school*	10	2350	15	2230	11	2330
College or university	5	2020	4	**	5	2020
Government { civilian	7	2040	18	2080	9	2080
Government { military	32	1960	18	1750	29	1920
Other	3	**	4	**	3	1920
Total	100%	$2085	100%	$2030	100%	$2085

**The high school salaries were calculated by dividing the annual salary by the number of months in the school year.*
***Insufficient data.*

Table X. Full-time employment* of new physics bachelors in the U.S., class of 1992.

Work activity		Type of employer: Industry manufacture	Industry service	High school	Government civilian	Government military	Coll. univ.	Other	Total N	Total %
Teaching		–	3	48	1	4	2	3	61	12%
Research & development		29	8	–	24	16	11	2	90	17
Development & design		43	12	–	7	1	–	–	63	12
Programming		9	17	–	9	5	7	–	47	9
Skilled labor		13	23	1	5	9	6	5	62	12
Specialized training**		1	1	–	–	59	–	–	61	12
Marketing		8	10	–	–	–	–	–	18	3
Nonphysics prof. work		18	42	–	4	25	3	6	98	19
Other		4	10	–	1	2	–	5	22	4
Total	N	125	126	49	51	121	29	21	522	
	%	24	24	9	10	23	6	4		100%
Use of physics training	Extensive	31%	10%	80%	50%	37%	36%	40%		34%
	Little	49	52	16	36	51	52	27		45
	None	20	38	4	14	12	12	33		21

**The employment of these 522 graduates includes both newly accepted positions as well as those in which graduates are continuing. Excluded are graduates in summer and foreign (N = 6) employment.*

***Training paid for by employer includes pilot/navigator training by the military.*

ASTRONOMY

To fulfill a science requirement, almost two-hundred thousand undergraduates enroll in an introductory astronomy course; but the number of students who major in astronomy shrinks that total to less than 200 graduates per year. There were 56 undergraduate departments that conferred 186 astronomy bachelor's degrees during the academic year 1991-92. The characteristics by postbaccalaureate plan of these graduates are presented in **Table XI** and are based on

Table XI. Characteristics of astronomy bachelors, 1991–92.

Characteristics		Postbaccalaureate plans: Graduate study Astronomy/Physics N	Graduate study Other N	Employment N	Undecided N	Total %
Initial interest in astronomy**	Home environment	15	2	6	1	21%
	Books, TV, etc.	10	2	4	–	14
	Curiosity about nature	22	2	11	2	33
Sex	Female	17	6	12	2	23%*
	Male	51	8	28	6	77
Citizenship	U.S.	64	13	40	8	97%*
	Foreign	4	1	–	–	3
Age	21	3	1	1	–	4%
	22	28	7	18	2	42
	23	19	4	12	4	30
	24	8	1	3	1	10
	25 or older	10	1	6	1	14
Type of degree	Bachelor of science	46	5	22	7	61%
	Bachelor of arts	22	9	18	1	39
Type of bachelor's institution	PhD-granting	52	9	27	7	77%*
	MS-granting	2	1	2	–	4*
	BS/BA-granting	14	4	11	1	19*
	Public	49	5	26	7	69%*
	Private	19	9	14	1	31*
Total respondents		68	14	40	8	130
Total number of astronomy bachelors		97	20	57	12	186*

**Data derived from the survey of Enrollments and Degrees.*

***The answers from the remaining respondents ranged from describing visits to a planetarium to mentioning the names of specific role models.*

130 astronomy bachelors who contributed their data to this survey. Compared to the physics graduates, the astronomy bachelors include proportionately more women, fewer minorities and more bachelor of arts degrees.

Table XII puts the postbaccalaureate plans into perspective by comparing the astronomy bachelors in the class of 1992 with those of three earlier classes. The shift toward graduate study and away from employment comes as no surprise when one compares the job opportunities at the bachelor's level with the available sources of support for graduate study. Additional details on the subjects of graduate study and the initial employment of 40 graduates are presented in **Figure III**.

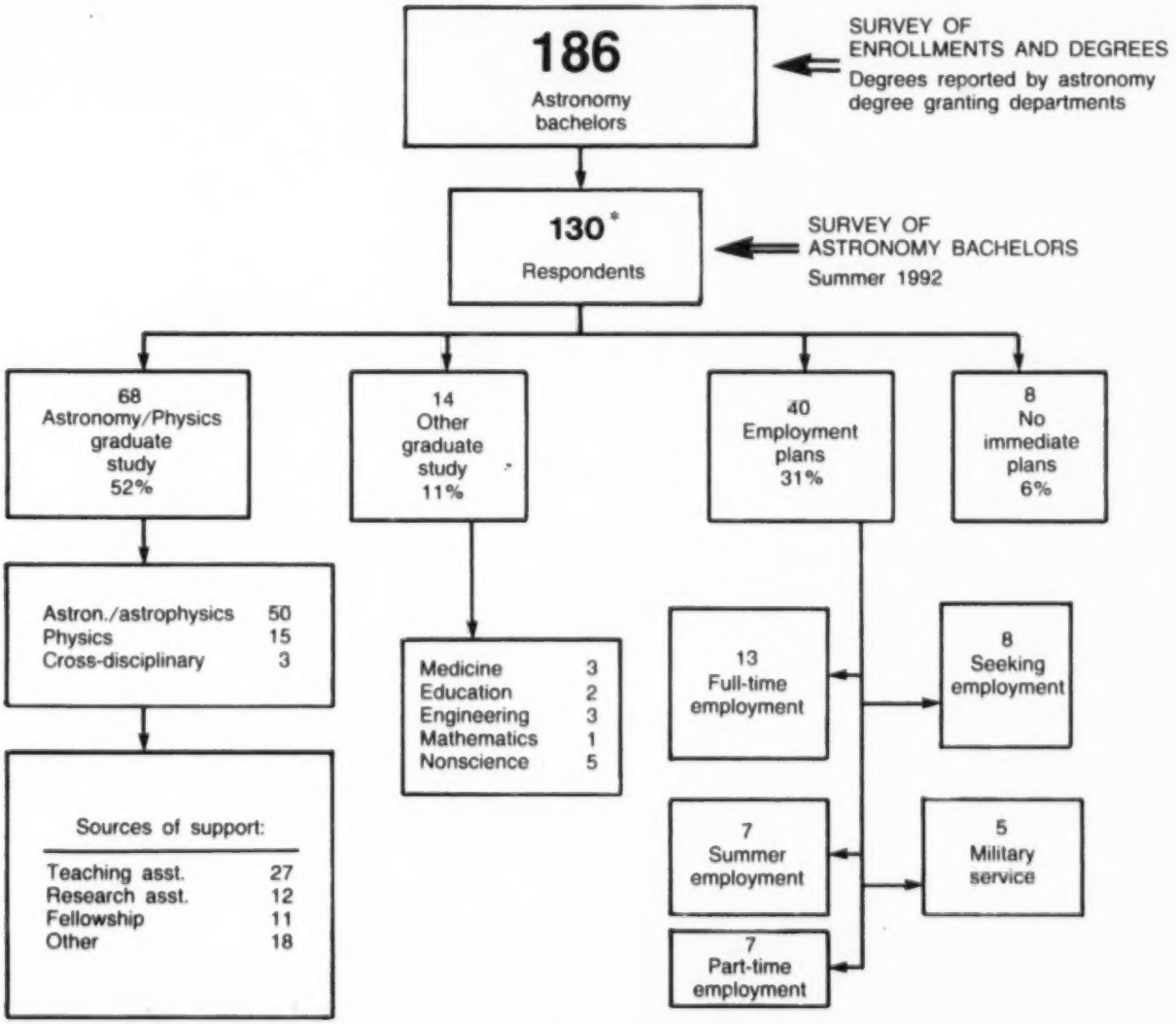
This report was prepared with the help of Thomas N. Stovall.

Table XII. Postbaccalaureate plans of selected graduating classes of astronomy bachelors, 1980 to 1992.

Postbaccalaureate plans	1979–80	1984–85	1989–90	1991–92
Astronomy/Physics graduate study*	42%	42%	46%	52%
Other graduate study	10	10	14	11
Employment	43	45	37	31
Undecided	5	3	3	6
Total number of astronomy bachelors	165	145	176	186

** Versions of this table published in earlier reports included physics under "Other graduate study."*

Figure III. Postbaccalaureate plans of astronomy bachelors of the class of 1992.



**Includes 25 physics bachelors from Figure II who reported a double major with astronomy.*